

# National Advisory Committee for Aeronautics

## Research Abstracts

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### CURRENT NACA REPORTS

NACA Rept. 1156

EXPERIMENTS TO DETERMINE NEIGHBORHOOD REACTIONS TO LIGHT AIRPLANES WITH AND WITHOUT EXTERNAL NOISE REDUCTION. Fred S. Elwell, Aeronautical Research Foundation. 1953. ii, 43p. diagrs., photos., 12 tabs. (NACA Rept. 1156. Formerly TN 2728)

Experiments to determine neighborhood reactions to the noise of light airplanes with and without noise-reduction equipment were conducted at a number of sites which might be convenient locations for landing strips within the metropolitan area of Boston, Mass. Two standard airplanes and two airplanes modified by reduction gears, four-bladed propellers, and engine exhaust silencers were used. Flights were made close to residential properties of varying income levels, population densities, and proximity to trade centers in order to determine whether the degree of noise reduction previously found to be aerodynamically and structurally practicable produced a significant reduction in neighborhood objections to such aircraft operations.

NACA Rept. 1157

ANALYTICAL DERIVATION AND EXPERIMENTAL EVALUATION OF SHORT-BEARING APPROXIMATION FOR FULL JOURNAL BEARINGS. George B. DuBois and Fred W. Ocvirk, Cornell Univ. 1953. ii, 32p. diagrs., photos., 4 tabs. (NACA Rept. 1157. Formerly TN 2808; TN 2809)

An approximate analytical solution including the effect of end leakage from the oil film of short plain bearings is presented because of the importance of endwise flow in sleeve bearings of the short lengths commonly used. The analytical approximation is supported by experimental data and includes the endwise flow and that part of the circumferential flow which is related to surface velocity and film thickness. Methods are also discussed for approximating a maximum bearing temperature for pressure-lubricated bearings and for evaluating the effect of deflection in misalignment on the eccentricity ratio at the ends of a bearing.

NACA Rept. 1166

RELATION BETWEEN ROUGHNESS OF INTERFACE AND ADHERENCE OF PORCELAIN ENAMEL TO STEEL. J. C. Richmond, D. G. Moore, H. B. Kirkpatrick and W. N. Harrison, National Bureau of Standards. 1954. ii, 9p. diagrs., photos., 7 tabs. (NACA Rept. 1166. Formerly TN 2934)

The relationship between adherence and roughness of interface between enamel and iron was studied. Porcelain-enamel ground coats were prepared and applied under conditions that gave various degrees of adherence. The variations were produced by (a) varying the amount of cobalt-oxide addition in the frit; (b) varying the type of metallic-oxide addition in the frit, keeping the amount constant at 0.8 weight percent; (c) varying the surface treatment of the metal before application of the enamel, by pickling, sandblasting, and polishing; and (d) varying the time of firing of the enamel containing 0.8 percent of cobalt oxide. A positive correlation was found between adherence and roughness of the interface.

NACA Rept. 1180

THEORETICAL STUDY OF THE TRANSONIC LIFT OF A DOUBLE-WEDGE PROFILE WITH DETACHED BOW WAVE. Walter G. Vincenti and Cleo B. Wagoner. (Portions of this work were reported at the eighth International Congress on Theoretical and Applied Mechanics, Istanbul, Turkey, August 20-28, 1952). 1954. ii, 24p. diagrs., 2 tabs. (NACA Rept. 1180. Formerly TN 2832)

Numerical calculations are described of the aerodynamic characteristics at small angle of attack of a thin, doubly symmetrical, double-wedge profile in the range of supersonic flight speed in which the bow wave is detached. The analysis is carried out within the framework of the transonic (nonlinear) small-disturbance theory. The following results are provided as functions of the transonic similarity parameter: (1) chordwise lift distribution, (2) lift-curve slope, and (3) position of center of lift.

NACA RM E53E29

IGNITION-DELAY DETERMINATIONS OF FURFURYL ALCOHOL AND MIXED BUTYL MERCAPTANS WITH VARIOUS WHITE FUMING NITRIC ACIDS USING MODIFIED OPEN-CUP AND SMALL-SCALE ROCKET ENGINE APPARATUS. Dezso J. Ladanyi, Riley O. Miller and Glen Hennings. February 1955. 17p. diagrs., photos., 4 tabs. (NACA RM E53E29)

Approximate linear relations were obtained when the logarithm of ignition delay was plotted against the reciprocal of absolute temperature for furfuryl alcohol and white fuming nitric acid (16 percent water) in the small-scale rocket engine (approximately 50 lb thrust) and for mixed butyl mercaptans and white fuming nitric acid (2 percent water) in the modified open-cup apparatus. Zero-temperature coefficients of ignition delay were obtained for furfuryl alcohol and white fuming nitric acid (2 percent water) in both apparatus for the temperature ranges investigated.

## NACA RM E54K10

**SOME MEASUREMENTS OF BOILING BURN-OUT.** Warren H. Lowdermilk and Walter F. Weiland. February 1955. 18p. diags., photo., 3 tabs. (NACA RM E54K10)

Measurements of boiling burnout heat flux for water flowing upward through an electrically heated tube were obtained for ranges of velocity from 0.1 to 19 feet per second; pressure from atmosphere to 2000 pounds per square inch; length-diameter ratios of 25, 37.5, and 50; and inlet subcooling from zero to 400° F. Unsteady flow was obtained for burnout conditions with a restriction located downstream of the point of burnout. A compressible fluid plenum chamber located between the restriction and the exit of the test section resulted in steady-flow burnout with a tenfold increase in the burnout heat flux.

## NACA RM E54L10

**MEASURED EFFECTIVE THERMAL CONDUCTIVITY OF URANIUM OXIDE POWDER IN VARIOUS GASES AND GAS MIXTURES.** J. S. Boegli and R. G. Deissler. March 1955. 20p. diags., tab. (NACA RM E54L10)

This study was undertaken as part of a series of investigations to determine the effective conductivity of UO<sub>2</sub> powder with a density of 59.5 percent of the density of the solid UO<sub>2</sub> at temperatures between 200° and 1500° F. Experimental effective conductivities of the gas-powder mixtures were determined for helium, argon, and nitrogen gases, and mixtures of helium-argon and xenon-krypton gases. All tests were performed at a gas pressure above the break-away pressure, where the thermal conductivity is independent of pressure. A method for determination of the relative thermal conductivity of the solid was devised from knowledge of the effective conductivity of the powder and the conductivity of the gases used in the two-phase system. This method was applied to the UO<sub>2</sub> used in this investigation.

## NACA TM 1340

**LIFT ON A BENT, FLAT PLATE.** (Auftrieb einer geknickten ebenen Platte). F. Keune. February 1955. 15p. diags. (NACA TM 1340. Trans. from Bericht der Aerodynamischer Versuchsanstalt Göttingen. Luftfahrtforschung, Mar. 20, 1936, Annual Volume, p. 85-87)

The lift on a bent, flat plate is calculated exactly by the use of conformal mapping. Results are presented in terms permitting direct determination of the angle of zero lift, the lift coefficient, and the lift-curve slope for any flap-chord ratio, flap-deflection angle, and angle of attack.

## NACA TM 1370

**SOME MEASUREMENTS OF TIME AND SPACE CORRELATION IN WIND TUNNEL.** (Quelques Mesures de Corrélation Dans le Temps et L'Espace en Soufflerie). A. Favre, J. Gaviglio and R. Dumas. February 1955. 21p. diags. (NACA TM 1370. Trans. from La Recherche Aéronautique, no. 32, Mar.-Apr., 1953, p. 21-28).

Results are presented of research obtained by means of an apparatus for measurement of time and space correlation and of a spectral analyser in the

study of the longitudinal component of turbulence velocities in a wind tunnel downstream of a grid of meshes. Application to the case of a flat-plate boundary layer is illustrated. These researches were made at the Laboratoire de Mécanique de l'Atmosphère de l'I. M. F. M. for the O. N. E. R. A.

## NACA TN 3281

**INTERGRANULAR CORROSION OF HIGH-PURITY ALUMINUM IN HYDROCHLORIC ACID. I - EFFECTS OF HEAT TREATMENT, IRON CONTENT, AND ACID COMPOSITION.** M. Metzger and J. Intrater, Columbia University. February 1955. 38p. photos., 8 tabs. (NACA TN 3281)

The intergranular corrosion of high-purity aluminum in hydrochloric acid was studied as a function of iron content, heat treatment, and acid composition under conditions where the rate of intergranular penetration was of the order of 1 millimeter per week. The behavior of specimens quenched to retain a single-phase structure indicated the rate of attack on the high-angle grain boundaries to be influenced by the segregation in these boundaries of iron and possibly other impurity atoms.

## NACA TN 3322

**AN ACCURATE AND RAPID METHOD FOR THE DESIGN OF SUPERSONIC NOZZLES.** Ivan E. Beckwith and John A. Moore. February 1955. 57p. diags., 3 tabs. (NACA TN 3322)

A procedure is given for designing two-dimensional nozzles in which the streamline coordinates are computed directly from tabulated flow parameters and appropriate equations. The method of characteristics was used to obtain the first part of the flow which consists of a continuous expansion from a uniform sonic flow to a radial flow. The Foelsch equations are used for the transition from this radial flow to the final uniform flow. Information is presented which enables the designer to select and compute rapidly the wall contour for any nozzle or series of nozzles for a wide range of length-to-height ratio, Mach number, and wall angle at the inflection point.

## NACA TN 3325

**SIMILAR SOLUTIONS FOR THE COMPRESSIBLE LAMINAR BOUNDARY LAYER WITH HEAT TRANSFER AND PRESSURE GRADIENT.** Clarence B. Cohen and Eli Reshotko. February 1955. 67p. diags., 2 tabs. (NACA TN 3325)

Stewartson's equations for the compressible laminar boundary layer with pressure gradient and heat transfer are solved for pressure gradients varying from that causing separation to the infinitely favorable gradient and for wall temperatures from absolute zero to twice the free-stream stagnation temperature. For the case of favorable pressure gradients with heated walls, it is shown that the velocity within a portion of the boundary layer must exceed the local external velocity. The variation of a Reynolds analogy parameter, which indicates the ratio of skin friction to heat transfer, is from zero to 7.4 for a surface of temperature twice the free-stream stagnation temperature and from zero to 2.8 for a surface held at absolute zero, where the value 2 applies to a flat plate.



NACA TN 3330

INGESTION OF FOREIGN OBJECTS INTO TURBINE ENGINES BY VORTICES. Lewis A. Rodert and Floyd B. Garrett. February 1955. 23p. diagrs., photos. (NACA TN 3330)

The ingestion of foreign objects by vortices formed between engine inlet and ground surface was investigated with a 5000-pound-thrust axial-flow jet engine. Pebbles, typical of objects that damage jet engines, were projected into the air by the vortices and were drawn into the engine by the high-velocity inlet-air stream. Vortex formation depended on engine speed, engine height, and surface wind. Pebbles lodged in surface cracks were more readily picked up than those exposed on a smooth surface. A motion-picture supplement may be obtained on loan from NACA Headquarters, Washington, D. C.

NACA TN 3339

EXPERIMENTS ON TURBULENT FLOW THROUGH CHANNELS HAVING POROUS ROUGH SURFACES WITH OR WITHOUT AIR INJECTION. E. R. G. Eckert, Anthony J. Diaguila and Patrick L. Donoughe. February 1955. 45p. diagrs., photos., tab. (NACA TN 3339)

Experiments were conducted to study the flow characteristics along porous rough surfaces with and without air injection for turbulent flow in a channel. Four degrees of roughness were studied with ratios of air-injection velocity to mainstream velocity from 0 to approximately 0.017. Velocity distributions along the rough porous surfaces and friction coefficients are presented.

NACA TN 3340

GENERALIZATION OF GAS-FLOW-INTERFEROMETRY THEORY AND INTERFEROGRAM EVALUATION EQUATIONS FOR ONE-DIMENSIONAL DENSITY FIELDS. Walton L. Howes and Donald R. Buchele. February 1955. 70p. diagrs., photos. (NACA TN 3340)

Generalized equations concerned with gas-flow interferometry are applied in developing interferogram evaluation equations for one-dimensional density fields. Theoretical limitations and systematic errors of the equations are investigated. Criteria for applicability and for avoiding apparent-ray-trace crossing are presented. The theory indicates that errors caused by an extended light source and test-section windows are negligible in practice. Analytical and experimental checks of the validity of the evaluation equations are presented. Theoretical results are compared with those of previous analyses.

NACA TN 3352

EXPERIMENTAL INVESTIGATION OF MISALINING COUPLES AND ECCENTRICITY AT ENDS OF MISALINED PLAIN BEARINGS. G. B. DuBois, F. W. Ocvirk and R. L. Wehe, Cornell University. February 1955. 81p. diagrs., photo., 3 tabs. (NACA TN 3352)

An experimental investigation was conducted to study the behavior of full journal bearings under steady load when acted on by a steady misaligning couple. Displacements of the ends of the journal axis were measured with either an axial couple

applied in the plane of the central load or a twisting couple in the plane normal to the central load. Oil-flow-rate and bearing-temperature measurements were also made to determine the effect of misaligning couples on these quantities.

NACA TN 3355

PRELIMINARY INVESTIGATION OF A STICK SHAKER AS A LIFT-MARGIN INDICATOR. James P. Trant, Jr. February 1955. 19p. diagrs., photos. (NACA TN 3355)

Preliminary tests with simulator equipment were made to determine the ability of subjects to use frequency or amplitude of vibration of the pilot's control stick, or both, as an indicator for maintaining a desired lift margin below the stall. The results showed that the desired lift margin could probably be maintained, provided the allowable variation from the desired angle of attack or lift coefficient produced either changes in amplitude of vibration of about 100 percent or changes in frequency of 40 percent, or both.

NACA TN 3368

ANALYSIS OF BEHAVIOR OF SIMPLY SUPPORTED FLAT PLATES COMPRESSED BEYOND THE BUCKLING LOAD INTO THE PLASTIC RANGE. J. Mayers and Bernard Budiansky. February 1955. 44p. diagrs. (NACA TN 3368)

An analysis is presented of the postbuckling behavior of a simply supported square flat plate with straight edges compressed beyond the buckling load into the plastic range. The method of analysis involves the application of a variational principle of the deformation theory of plasticity in conjunction with computations carried out on a high-speed calculating machine. Numerical results are obtained for several plate proportions and for one material. The results indicate plate strengths greater than those that have been found experimentally on plates that do not satisfy straight-edge conditions.

NACA TN 3369

MINIMUM-DRAG BODIES OF REVOLUTION IN A NONUNIFORM SUPERSONIC FLOW FIELD. Conrad Rennemann, Jr. February 1955. 25p. diagrs. (NACA TN 3369)

A general expression for the cross-sectional-area distribution of the minimum-drag body of revolution of given volume and length in a nonuniform supersonic flow field is derived on the basis of linearized theory. This result is applied to the determination of the minimum-drag body of revolution of given volume and length located in the flow field of a parabolic body of revolution. The interference pressures from a main body acting on a satellite body have a negligible effect on the shape for minimum wave drag of the satellite body.

NACA TN 3371

ANALYSIS OF ACCELERATIONS, GUST VELOCITIES, AND AIRSPEEDS FROM OPERATIONS OF A TWIN-ENGINE TRANSPORT AIRPLANE ON A TRANSCONTINENTAL ROUTE FROM 1950 TO 1952. Thomas L. Coleman and Walter G. Walker. February 1955. 16p. diagrs., 3 tabs. (NACA TN 3371)

VGH time-history data obtained from one type of twin-engine transport airplane during operations from 1950 to 1952 on a transcontinental route are analyzed in order to determine the magnitude and frequency of occurrence of gust accelerations, gust velocities, and the associated airspeeds and altitudes. The present results compared favorably with results previously obtained for a similar type of twin-engine airplane during other operations. The present operations indicate a less severe acceleration history than that shown for the other airplane, apparently because of the lower operating airspeed in rough air.

## NACA TN 3389

AXIALLY SYMMETRIC SHAPES WITH MINIMUM WAVE DRAG. Max. A. Heaslet and Franklyn B. Fuller. February 1955. 46p. diags. (NACA TN 3389)

Optimum bodies consisting of a basic cylinder with added peripheral volume are derived and presented in terms of the effective radius-length ratio. Variation of this parameter from 0 to  $\infty$  encompasses the spectrum of results from slender to two-dimensional. A reciprocal theorem leads to simple interpretations of variational problems.

## NACA TN 3396

ICING LIMIT AND WET-SURFACE TEMPERATURE VARIATION FOR TWO AIRFOIL SHAPES UNDER SIMULATED HIGH-SPEED FLIGHT CONDITIONS. Willard D. Coles. February 1955. 33p. diags., photos. (NACA TN 3396)

The variation of wet-surface temperature and the conditions that will result in ice-free surfaces for high-speed flight through clouds were investigated experimentally. The results are compared with calculated values obtained with an analytical method. The analytical results were generally conservative, giving wet-surface temperatures  $2^{\circ}$  to  $4^{\circ}$  F lower than the experiments and predicting the formation of ice at values of ambient-air temperature up to  $12^{\circ}$  F higher than the experiments. The location of analytically determined critical regions on the bodies for the initial formation of ice was experimentally substantiated.

## NACA TN 3397

AN EVALUATION OF NON-NEWTONIAN FLOW IN PIPE LINES. Ruth N. Weltmann. February 1955. 40p. diags., tab. (NACA TN 3397)

An analysis is presented of a method for determining pressure losses due to the flow of non-Newtonian materials in pipe lines by using basic flow data obtained from measurements of flow curves, which are rate-of-shear - shearing-stress curves. The advantages of properly designed rotational viscometers over capillary viscometers for measuring these flow curves and interpreting them to obtain the basic flow parameters are discussed. Dimensionless parameters are calculated from these basic flow data and are used to construct a generalized friction diagram to describe the flow characteristics of Newtonian and non-Newtonian materials in pipe lines.

## NACA TN 3398

A THERMAL EQUATION FOR FLAME QUENCHING. A. E. Potter, Jr. and A. L. Berlad. February 1955. 18p. diags., tab. (NACA TN 3398)

A thermal quenching equation is derived; the equation is essentially an extension of a previously proposed diffusional concept. By proper choice of the rate-controlling chemical reaction, the equation becomes suitable for use with rich as well as lean fuel-air mixtures. The equation was tested, using published quenching-distance data for propane-oxygen-nitrogen flames, which include the effect of oxygen-nitrogen ratio, equivalence ratio, pressure, and initial temperature.

## NACA TN 3402

BOUNDARY LUBRICATION OF STEEL WITH FLUORINE- AND CHLORINE-SUBSTITUTED METHANE AND ETHANE GASES. S. F. Murray, Robert L. Johnson and Max A. Swikert. February 1955. 17p. photos., diags., 2 tabs. (NACA TN 3402)

Sliding-friction experiments were made with steel surfaces in atmospheres of halogenated gases. Under the conditions of this investigation, the most stable or fully fluorinated gases gave no surface protection. Several fluorinated compounds containing two or more chlorine atoms per molecule served as effective boundary lubricants (reduced friction and prevented excessive wear, surface welding, and metal transfer) in a manner comparable with a conventional liquid lubricant. Run-in procedure, bearing materials, and moisture availability appear to be critical in boundary lubrication by gaseous materials.

## NACA TN 3405

TEMPERATURE-COMPOSITION LIMITS OF SPONTANEOUS EXPLOSION FOR NINE ALKYL-SILANES WITH AIR AT ATMOSPHERIC PRESSURE. Rose L. Schalla and Glen E. McDonald. February 1955. 13p. diags. (NACA TN 3405)

To provide safe-handling information, the spontaneous explosion limits of nine alkylsilanes were determined as a function of temperature and fuel-air composition at a pressure of 1 atmosphere. Over a fuel concentration range of about 2 to 9 percent by volume, the fuels studied were nonexplosive below the following temperatures: tetramethylsilane  $(\text{CH}_3)_4\text{Si}$ ,  $450^{\circ}\text{C}$ ; trimethylsilane  $(\text{CH}_3)_3\text{SiH}$ ,  $300^{\circ}\text{C}$ ; diethylsilane  $(\text{C}_2\text{H}_5)_2\text{SiH}_2$ ,  $255^{\circ}\text{C}$ ; dimethylsilane  $(\text{CH}_3)_2\text{SiH}_2$ ,  $220^{\circ}\text{C}$ ; ethylsilane  $(\text{C}_2\text{H}_5)\text{SiH}_3$ ,  $215^{\circ}\text{C}$ ; isobutylsilane  $(i\text{-C}_4\text{H}_9)\text{SiH}_3$ ,  $200^{\circ}\text{C}$ ; *n*-butylsilane  $(n\text{-C}_4\text{H}_9)\text{SiH}_3$ ,  $185^{\circ}\text{C}$ ; methylsilane  $(\text{CH}_3)\text{SiH}_3$ ,  $125^{\circ}\text{C}$ ; and vinylsilane  $\text{H}_2\text{C}=\text{CH-SiH}_3$ ,  $90^{\circ}\text{C}$ .

## NACA TN 3409

CHAIN BREAKING AND BRANCHING IN THE ACTIVE-PARTICLE DIFFUSION CONCEPT OF QUENCHING. Frank E. Belles and A. L. Berlad. February 1955. 37p. diags., 3 tabs. (NACA TN 3409)

General quenching-distance equations that take into account gas-phase chain breaking and branching and



the effect of the wall efficiency for destruction of active particles are derived as extensions of the original simple theory of quenching by diffusion of active particles. The general characteristics of the equations are discussed. Quenching distance data from the literature for propane-oxygen-nitrogen mixtures are treated in a consistent manner. The effects of elevated initial mixture temperature are predicted and agree qualitatively with observed trends. It is found that the simple theory correlates all the data satisfactorily.

## BRITISH REPORTS

N-34309\*

Royal Aircraft Establishment (Gt. Brit.)  
METHODS OF DETERMINATION AND OF FIXING  
BOUNDARY LAYER TRANSITION ON WIND TUNNEL  
MODELS AT SUPERSONIC SPEEDS. K. G. Winter,  
J. B. Scott-Wilson and F. V. Davies. September  
1954. 27p. diags., photos. (RAE Tech. Note  
Aero 2341)

An account is given of methods used in supersonic wind tunnels for observation of boundary-layer phenomena, in particular of the sublimation and oil film techniques. Examples are given of the uses of these techniques. On the fixing of transition, a rough guide is given for the minimum size of wire required, with an example of the use of wires. The results of a brief experiment on the profile of an artificially promoted turbulent boundary layer are given.

N-34820\*

Royal Aircraft Establishment (Gt. Brit.)  
SOME NOTES ON A PROPOSAL TO USE A BLOWER  
TUNNEL FOR VISION IN RAIN TESTS ON AIRCRAFT  
WINDSCREENS. F. J. Bigg. September 1954. 16p.  
diags., 2 tabs. (RAE Tech. Note Mech. Eng. 187)

For research work on vision through aircraft wind-screens in rain, it has been suggested many times that ground tests should be made using a blower tunnel with simulated rain. This note describes some tests and calculations, which have recently been made, from which it has become apparent that it is not possible to produce realistic rain conditions by this method. The possibility of using a large vertical wind tunnel has also been considered theoretically and it is concluded that this would also be impracticable.

N-34821\*

Royal Aircraft Establishment (Gt. Brit.)  
DEVELOPMENT OF AN AIR MASS-FLOW RATE  
METER. W. J. G. Cox. October 1954. 47p.  
diags., photos. (RAE Tech. Note Instn. 142)

The development of an air mass flow rate meter to cover a very wide range is described which, essentially an analogue computer, gives a two-sweep pointer direct presentation of air mass flow rate, independent of pressure, temperature, and velocity changes within the range of the instrument. The pointers are driven by a servo system which is error-actuated from the computing bridge network, secondary feedback being employed to maintain stability with a saturated angular output rate of ap-

proximately 33° per second. Specifications and performance figures are given for the individual transducer elements and the complete instrument, error estimations are made, and the servo stability is discussed.

N-34849\*

Royal Aircraft Establishment (Gt. Brit.)  
THEORETICAL LOAD DISTRIBUTIONS ON FIN-  
BODY-TAILPLANE ARRANGEMENTS IN A SIDE-  
WIND. J. Weber and A. C. Hawk. August 1954.  
113p. diags., 6 tabs. (RAE Aero 2518)

A theory is developed for calculating the distributions of side force and lift on fin-fuselage-tailplane arrangements in a sidewind but with the tailplane set at zero angle of attack. The results can be extended to other arrangements and to compressible subcritical flow and are required for stability and stressing analysis. This paper is a continuation of a report in which the interference between fin and fuselage was considered. The addition of the tailplane brings changes in the load distribution as well as in the overall forces. The main functions needed for representative cases are given in tables and charts. Results for other geometrical arrangements can be obtained by interpolation.

N-34878\*

Aeronautical Research Council (Gt. Brit.)  
THE CRITICAL WHIRLING SPEEDS AND NATURAL  
VIBRATIONS OF A SHAFT CARRYING A SYM-  
METRICAL ROTOR. E. Downham. 1954. 13p.  
diags., photo. (ARC R & M 2854; ARC 13,917.  
Formerly RAE Structures 97)

The experiments described in this report are part of a program of model experiments designed to establish an accurate method for calculating the critical whirling speeds of complex systems. The critical whirling speeds and natural vibrations of a single shaft flexibly supported and carrying a flexible rotor of appreciable moment of inertia have been investigated and good agreement has been obtained between experimental and calculated results for the rotating system.

N-34879\*

Aeronautical Research Council (Gt. Brit.)  
THE INFLUENCE OF ROLLING MOMENTS ON  
SPIN RECOVERY AS OBSERVED IN MODEL-  
SPINNING TESTS. D. J. Harper. 1954. 13p.  
diags., tab. (ARC R & M 2831; ARC 13,538.  
Formerly RAE Aero 2365)

Several aspects of model-spinning test technique have been brought into prominence by full-scale developments. Correlation between model and full-scale recoveries has been poor in some cases, and it appears that full-scale recovery may depend on some other means in addition to the normal use of rudder and elevator. Analysis of data shows the effects of applied rolling moments and of aileron deflections on both spin and recovery to be closely related to the distribution of loading of the aircraft. The ordinary model-test result can be in error due to scale effects on rolling moments. This report collects the available model data on the effects of applied rolling moments, and also includes model data on the use of ailerons to assist recovery.

N-34880\*

Aeronautical Research Council (Gt. Brit.)  
THEORETICAL SUPERSONIC DRAG OF NON-LIFTING INFINITE-SPAN WINGS SWEEPED BEHIND THE MACH LINES. T. Nonweiler. 1954. 22p. diags., 3 tabs. (ARC R & M 2795; ARC 13,896. Formerly RAE Tech. Note Aero 2073)

The wing section is assumed to be arbitrary but identical over the entire wing span. The drag is found according to the linear equations of supersonic flow by considering the flow due to a system of superposed source planes. The drag is found to be finite and the effect of the speed of flight independent of the section shape assumed. The variation of drag with the section shape is shown to be proportional to the integral over the chord of the product of the local wing thickness and the value of the excess pressure existing in incompressible flow at the same position. Methods of reducing drag by changing the section shape are considered.

N-34928\*

Royal Aircraft Establishment (Gt. Brit.)  
TRIALS OF 3 FT. DROGUE TARGET. D. R. Bettison and A. Eldridge. August 1954. 14p. diags., photo., 4 tabs. (RAE Tech. Note Mech. Eng. 185)

It was established by flight trials that the 1-ft 6-in. throat x 3-ft tail x 15-ft long drogue target manufactured in R. F. D. 3272/N nylon rip-stop is satisfactory for speeds up to 300 kts I. A. S. D. T. D. 778 material is inadequate for present requirements for all drogue sizes, and it recommended that it be replaced by a stronger material.

N-34929\*

Royal Aircraft Establishment (Gt. Brit.)  
SOLUTION OF AERO-ELASTIC PROBLEMS BY MEANS OF INFLUENCE COEFFICIENTS. D. Williams. November 1954. 12p. diagr. (RAE Structures 169)

It is shown that, on the basis of the data provided by two sets of influence coefficients for a wing (or other surface) - and "elastic" set giving deflections (and hence incidence angles) in terms of applied loads, and an aerodynamic set giving aerodynamic loads in terms of incidence angles - all "static" aeroelastic problems can easily and expeditiously be solved by the use of a digital computer. It is also suggested that the same method of approach may well be used for solving oscillatory aeroelastic problems such as flutter.

N-34930\*

Nat. Gas Turbine Establishment (Gt. Brit.)  
A NOTE ON THE COOLING OF TURBINE ROTOR BLADES BY WATER JETS. K. R. F. Kenworthy. October 1954. 6p. (NGTE Memo. M. 227)

Experimental work at N. G. T. E. on "spray" or "jet" cooling is reviewed and a performance estimate given in comparison with air cooling. It is shown that the gains realizable as a result of the higher maximum cycle temperature are much the same in the two cases. The detrimental effects of the water and, in aircraft applications, the weight of water to be carried lead to the conclusion that spray cooling is inferior to air cooling.

N-34931\*

Royal Aircraft Establishment (Gt. Brit.)  
THE SLIP BAND EXTRUSION EFFECT IN COLD ROLLED, SUPER PURITY ALUMINUM. C. A. Stubbington and P. J. E. Forsyth. October 1954. 7p. photos. (RAE Tech. Note Met. 205)

It has been found that by cold rolling pure aluminum to a suitable degree, a slip band extrusion effect can be produced by subsequent fatigue stressing. This effect has been shown to be due to local recrystallization producing soft regions along slip striations, and is analogous to the soft regions produced in aluminum -4 percent copper by accelerated overaging under the action of fatigue stresses.

N-34934\*

Royal Aircraft Establishment (Gt. Brit.)  
INTRODUCTORY NOTES TO THE PROBLEMS OF AERODYNAMIC HEATING. R. J. Monaghan. October 1954. 19p. diags. (RAE Tech. Note Aero 2346)

This note gives a simplified discussion of the aerodynamic heating problems encountered in high-speed flight, illustrates their magnitude, and considers some means of alleviation. Although the temperatures for zero heat transfer between airstream and aircraft increase rapidly with increase of flight speed, some alleviation can be obtained by choosing a surface finish which loses heat freely by radiation. In addition, small thicknesses of external insulation could be extremely effective in protecting the main structure and the amounts of heat which enter the interior of the aircraft need not be excessive.

N-34936\*

Royal Aircraft Establishment (Gt. Brit.)  
AN ELECTROLYTIC METHOD FOR THE DIRECT PRODUCTION OF MAGNESIUM LITHIUM ALLOYS FROM LITHIUM CHLORIDE. J. Smolinski, J. C. Hannam and A. L. Leach. October 1954. 19p. diags., photos., 9 tabs. (RAE Met. 80)

Magnesium lithium alloys were made directly at high current efficiency by electrolytic deposition of lithium on to a magnesium cathode from a molten 50 LiCl/50 KCl or 75 LiCl/25 BaCl<sub>2</sub> electrolyte at 560° to 630° C. The relation between sodium contamination in electrolyte and product has been determined. By careful selection of cell materials to avoid sodium contamination, alloys ductile in the aged condition could be made directly without need of refining.

N-34937\*

Royal Aircraft Establishment (Gt. Brit.)  
A RATE GYRO FOR USE IN AIRCRAFT DYNAMIC RESPONSE WORK. Keith Smith. October 1954. 13p. diags., photos. (RAE Tech. Note Aero 2327)

An instrument to measure angular rate under dynamic conditions, used in conjunction with a galvanometer recorder, has been developed from the existing standard instrumentation rate gyro (Type IT 2-1). With a range of  $\pm 8^\circ$  per second, it has considerably improved dynamic response characteristics. Tests on an oscillating table indicate that the response is flat ( $\pm 2$  percent of static value) up to 8 cycles per



second for an amplitude of  $\pm 6^\circ$  per second. Tests at a smaller amplitude were impractical but it is suspected that under these conditions the presence of nonlinear dynamic characteristics might cause a less satisfactory response.

N-34938\*

Royal Aircraft Establishment (Gt. Brit.)  
THE DETERMINATION OF MAGNESIUM OXIDE IN MAGNESIUM. H. J. Allsopp. October 1954. 10p. diagr., 6 tabs. (RAE Met. 79)

In the method described, magnesium metal is removed by sublimation in vacuum, the residue dissolved in acid, and the magnesium content determined volumetrically by disodium ethylene diamine tetra-acetate.

N-34939\*

Royal Aircraft Establishment (Gt. Brit.)  
GEOMETRICAL ANALYSIS OF SCHLIEREN PHOTOGRAPHS OF THE FLOW IN THE PLANE OF INCIDENCE OF INCLINED CONE-CYLINDERS AT SUPERSONIC SPEEDS. K. G. Winter. November 1954. 15p. diagrs., photo., tab. (RAE Tech. Note Aero 2345)

Measurements have been made of shock wave positions shown on schlieren photographs of the flow past inclined cone-cylinders. The resulting angles and distances have been correlated to give a general method of estimating the positions of the nose shock waves. The method is satisfactory at Mach numbers between 1.4 and 2.0 for cone-cylinders of semiangle less than  $15^\circ$ , at incidences up to  $30^\circ$ , and is of use in the design of models for supersonic wind tunnels.

N-34950\*

Royal Aircraft Establishment (Gt. Brit.)  
AN INTEGRATING AMPLIFIER FOR INSTRUMENTATION. E. T. de la Perrelle. September 1954. 18p. diagrs. (RAE Tech. Note Instn. 144)

The note discusses the use and design of amplifiers the output of which resembles, in essential features, the integrand with respect to time of the input. The relations between the gain and phase displacement versus frequency characteristics required to produce the desired result are shown to be a compromise, which is realizable in practice. A feedback integrator, which attenuates at frequencies below the lower limit of integration, is analyzed and discussed.

N-34951\*

Royal Aircraft Establishment (Gt. Brit.)  
ACCURACY AND SLIP TESTS PERFORMED ON A SINE AND COSINE BALL RESOLVER. B. Pounder. October 1954. 12p. diagrs., photo. (RAE Tech. Note IAP 1034)

A description is given of the methods used and the results obtained from the tests performed on a 1-inch ball resolver under development by IAP department. The following tests were performed: accuracy of resolution on no load; percentage slip of the output shafts for several applied torques and different angles; and the torque required to drive the input shaft for several values of the output load.

N-34953\*

Royal Aircraft Establishment (Gt. Brit.)  
NOTES ON THE INTERNATIONAL SYMPOSIUM ON MACROMOLECULAR CHEMISTRY HELD AT MILAN AND TURIN, 26TH SEPTEMBER - 2ND OCTOBER, 1954. W. W. Wright. November 1954. 19p. (RAE Tech. Note Chem. 1239)

General comments on a group of papers being followed by more detailed accounts of those papers appearing to the author to be of greater interest are given. A list of all the papers presented at this conference on macromolecular chemistry is given, and those available as preprints are marked.

N-34956\*

Royal Aircraft Establishment (Gt. Brit.)  
A GENERAL METHOD (DEPENDENT ON THE AID OF A DIGITAL COMPUTER) FOR DERIVING THE STRUCTURAL INFLUENCE COEFFICIENTS OF AEROPLANE WINGS. D. Williams. November 1954. 32p. diagrs., tab. (RAE Structures 168)

A general method (requiring the aid of a digital computer) is described for deriving the influence coefficients of any type of wing, and hence for evaluating its strength and stiffness characteristics. The method allows for shear deflections, and hence implicitly takes account of effects like shear-lag and warping of wing cross-sections. A rapid method accurate enough to serve as a basis for dynamical calculations is first described, and secondly a more rigorous method on which to base final stressing of the structure.

N-34957\*

Royal Aircraft Establishment (Gt. Brit.)  
STUDIES OF FLAMES BURNING WITH CHLORINE TRIFLUORIDE. G. Skirrow, R. A. M. Straker and H. G. Wolfhard. September 1954. 19p. diagr., photos., tab. (RAE RPD 22)

Diffusion flames are described in which fuels such as hydrogen, carbon monoxide, carbon disulphide, water, ammonia, hydrocarbons, and organic halides are burnt with chlorine trifluoride. Chemical equilibrium is nearly established in the main reaction zone as in an oxygen diffusion flame but the chlorine trifluoride flames possess several unusual features. Carbon formation is very heavy with hydrocarbon fuels and it may even impair combustion. Radicals such as  $C_2$  and CN have an unusually long lifetime and their presence in a high-temperature region enhances the luminosity of some of the flames. It is suggested that the persistence of these radicals may be due to the very rapid diffusion of hydrogen into the main reaction zone which effectively prevents the penetration of fluorine to the fuel side of the flame.

N-34959\*

Royal Aircraft Establishment (Gt. Brit.)  
THE CALCULATION OF THE PRESSURE DISTRIBUTION ON THICK WINGS OF SMALL ASPECT RATIO AT ZERO LIFT IN SUBSONIC FLOW. J. Weber. September 1954. 66p. diagrs., 4 tabs. (RAE Aero 2519)

The method of expressing the velocity increment over airfoils directly in terms of the section ordinates is extended to cover also straight and swept

wings of finite aspect ratio. The wings considered are untapered in plan form but may be tapered in thickness. The section can be of any given shape. Coefficients required in the calculation are tabulated for the center section of straight and sweptback wings of aspect ratios 0.5, 1, 2, and 4. The remaining calculations can be made very quickly. Since wings of very small aspect ratio can be treated also by the method of slender-body theory, the relations between linear theory, slender-body theory, and linearized slender-body theory are discussed.

N-34964\*

Royal Aircraft Establishment (Gt. Brit.)  
THE EFFECT OF ASPECT RATIO ON THE CHORDWISE LOAD DISTRIBUTION OF FLAT AND CAMBERED RECTANGULAR WINGS. J. Weber. October 1954. 40p. diagrs., 2 tabs. (RAE Aero 2525)

The report deals with the "first problem" of airfoil theory, that of determining the shape of the airfoil for a given load distribution. The downwash integral over wing and wake, which is involved in this calculation, is reduced to a very simple form which permits a rapid numerical evaluation for wings of rectangular plan form. This method has been used to check the accuracy of the results of various methods of calculation for small aspect ratio plane rectangular wings by inserting the calculated load distributions into the downwash equation and determining the airfoil shape which is then compared with the plane wing, for which the load distribution was calculated.

N-34965\*

Royal Aircraft Establishment (Gt. Brit.)  
THE PRESSURE DISTRIBUTION, (ACCORDING TO THE LINEAR THEORY), ON THE GROUND DUE TO A DELTA WING IN STEADY LEVEL SUPERSONIC FLIGHT. G. M. Roper. November 1954. 45p. diagrs. (RAE Tech. Note Aero 2332)

Effects of angle of attack and thickness are calculated separately, and the results are superimposed. Calculations are made for delta wings of single-wedge section and double-wedge section. The results are given in graphic form. The results can only be expected to give a very rough indication of the actual pressure distribution, since the fluid medium is assumed to be homogeneous, and no account is taken of shock waves. More recent work suggests that, in general, the pressures are overestimated. In particular, no significance should be attached to the very high pressures that occur in the very small region immediately behind the Mach wave from the trailing edge.

N-34966\*

Royal Aircraft Establishment (Gt. Brit.)  
THE EFFECT OF LOW TEMPERATURES ON THE FATIGUE AND TENSILE PROPERTIES OF SOME LIGHT ALLOYS, NOTCHED AND UNNOTCHED. N. J. F. Gunn. October 1954. 40p. diagrs., photo., 20 tabs. (RAE Tech. Note Met. 207)

Fatigue and tensile tests have been made on six light alloys at room and sub-zero temperatures, to ascertain the increase in properties at the low temperatures. The materials used were aluminum alloys D.T.D. 683, D.T.D. 363A, D.T.D. 364B (with two dif-

ferent heat treatments) magnesium alloy Z3Z, and a 12 percent magnesium lithium binary alloy. It was found that the fatigue and tensile properties did improve at the low temperatures, but the percentage increase was not very great.

UNIVERSITY OF FLORIDA



N-34968\*

Ministry of Supply (Gt. Brit.)  
EXPERIENCE OF FATIGUE AT WEYBRIDGE. H. H. Gardner. (Part one of final report prepared by Vickers-Armstrong, Ltd., Weybridge). November 1954. 37p. diagrs., photo. (Ministry of Supply. S & TM 10/54)

During 1942-44 a number of fatigue failures occurred on Wellington aircraft in service. The majority of failures occurred in main spar booms on the tension flanges, resulting in all cases in the loss of the aircraft and the complete crew. This report outlines the causes of these failures and describes the steps which were taken to modify the design, together with the experimental evidence which led to the final form of modification adopted. It is decided that the detail design of the joint was responsible for high stress concentrations at the base of the serrations, and the material of the spar tubes due to the method of manufacture contained high initial tension stresses which increased the tension stresses at the serrations to serious proportions.

## MISCELLANEOUS

NACA TN 3263

Errata on "LIFT AND MOMENT EQUATIONS FOR OSCILLATING AIRFOILS IN AN INFINITE UNSTAGGERED CASCADE." Alexander Mendelson and Robert W. Carroll. October 1954.

## UNPUBLISHED PAPERS

N-35236\*

Cornell University, Graduate School of Aeronautical Engineering. THE KINETIC ASPECT OF PLASTICITY. C. Riparbelli. February 1954. 68p. diagrs., photo. (Cornell University, Graduate School of Aeronautical Engineering)

The aim of the present paper is that of collecting some of the information available on plastic flow, with particular attention to plastic flow in copper and to its relation to the stress and strain, in order to explain some phenomena observed in the propagation of strain in a bar undergoing longitudinal impact and to eliminate an apparent contradiction between two groups of data.